D7.1 Designing and development of training material and delivery mechanisms

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DISSEMINATION LEVEL

PU	Public	x
PP	Restricted to other programme participants (incl. Commission Services)	
RE	Restricted to a group specified by the consortium (incl. Commission Services)	
CO	Confidential, only for the members of the consortium (incl. Commission Services)	

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1 Introduction

Nowadays, manufacturing education addresses some of the major challenges concerning the industrial learning and training aspects. New skills are required by the future generations of "knowledge workers". To that direction, an adaptation of the educational content and its delivery mechanisms to the new requirements of knowledge-based manufacturing is required. Manufacturing education should care about the provision of integrated engineering competencies and strong multi-disciplinary background. On the other hand, there is a growing need for expanding the technological aspect of education, with an extension to the 'soft skills. On top of that, within a global environment, there is a need that key manufacturing-oriented actors, such as human resources and knowledge / information, become more international.

The rapid advancements in manufacturing technology and ICT (Information Communications Technology) necessitate a continuous update of the knowledge content and delivery schemes for manufacturing education. The comprehension of the technical essence and of the business potential of new knowledge / technology is essential for its smooth adaptation and integration into the industrial working practice

TRINITY Project has identified several training needs from the interested stakeholders. Based on these needs and on the Competences provided by each partner TRINITY will implement an innovative education and training methodology in order to:

1. Increase awareness on the achievements of recent ICT and the potential of actual and future research in ICT.
2. Promote with that way the TRINITY Internal and external demonstrators
3. Validate new learning schemes according to the future needs for knowledge of technologies and skills
4. Identify the needs for future research regarding industrial learning and teaching process.

The Figure 1 presents the process that has been followed for generating the results that are included in this deliverable.

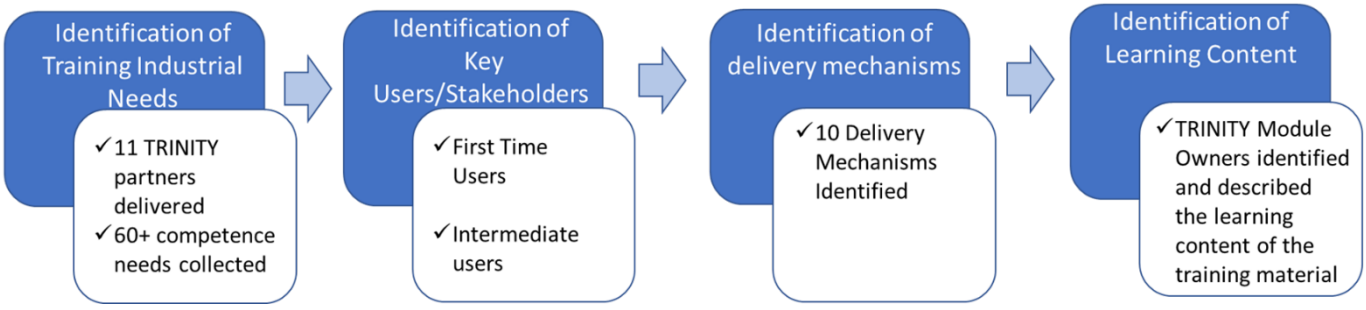

Figure 1: Delivery mechanisms identification process

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2 Development of TRINITY training Material and delivery's mechanism definition

TRINITY aims at applying an industrial learning methodology focusing on four major steps regarding learning process illustrated in Figure 2:

- Awareness - The aim is to raise awareness on new ICTs, attract the interest of first time and intermediate users to the Internal demonstrators and modules, and eliminate their possible concerns and/or negative view to "robotics"
- Knowledge - The aim is to depict new ICT knowledge developed by TRINITY, organize and classify the knowledge in a way being close to industrial practices and way of thinking, provide access to this knowledge.
- Skills - The aim is to support new users and SMEs (Small and medium-sized enterprises) to adopt novel and advanced ICT and robotics the comprehension and use of new ICT knowledge through training.
- Competence - The aim is to address training needs for a systematic, but also visionary, use and exploitation of knowledge and skills for innovating industrial robotic technologies and processes also to familiarize the participants with ICT training tools.

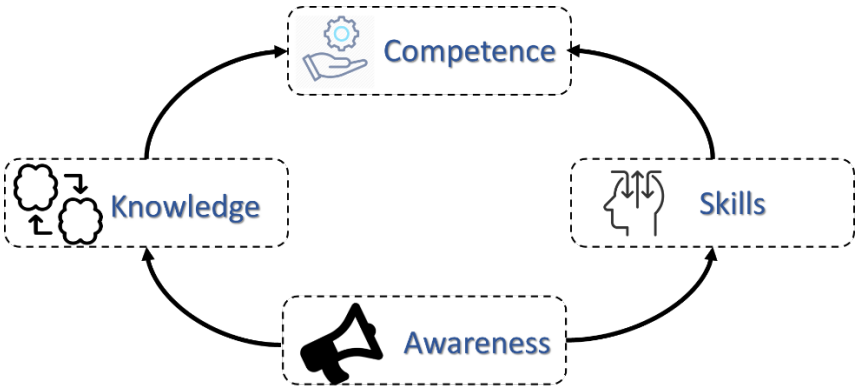

Figure 2 TRINITY Training Material development process

The TRINITY training material will:

- Will define in easily perceived ways the business potential of the new knowledge developed in research projects as are the TRINITY Modules and to use as also to use the education and knowledge transfer to approach SMEs
- facilitate the comprehension of the technical essence of new knowledge developed in research projects (i.e. focus on knowledge and skills)
- identify practical approaches for the integration of new knowledge developed in research projects into the industrial working practices and products (i.e. focus on competence)

This deliverable shows that steps have been followed by TRINITY partners in order to define the delivery mechanisms and to design the outline of the TRINITY Training Material. Analysis and prioritization of training needs and the possible interests are reported on section 3, review on Academic and industrial previous practices is reported in the next section. Additionally, the learning content of the material is

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specified by TRINITY Module owners in section 4 and at the subsections. Lastly, the results of the above are led to Step 5.

Step 1: Identification of Training Industrial Needs
This step deals with the definition of the training needs on ICT in manufacturing of the target groups identified in the previous step. Because of the individuality of needs in ICT competencies a survey was organized and filled in by TRINITY partners. However, more details about this section can be found on section 2.

Step 2: Identification of Key Users/Stakeholders
The aim of this step is to identify who will benefit from the training courses on ICT in manufacturing to be developed in TRINITY project. ICT in manufacturing is a cross-over activity and affects nowadays almost all roles in manufacturing companies. The most important roles are listed hereafter:

Step 3: Review on Academic and industrial previous practices
The available delivery mechanisms were specified, firstly at this step, through a review of academic and industrial practices

Step 4: Identification of Learning Content
The learning content which allows fulfilling the requirements of the different Key Users is developed in the current step. To achieve that, TRINITY Module owners analysed and identified the learning content that the Participants will need in order to get familiarized with their modules

Step 5: Identification of delivery mechanisms
In the Table 1 an overview about the delivery mechanisms is given.

Table 1 Overview of delivery mechanisms

Delivery Mechanisms / **Modules**	**Video /Tutorial**	**Presentation**	**Work shops**	**Virtual classroom**	**On Site: Seminar / Workshop / Conference / Lecture**	**Quiz**	**Q& A**	**Innovative Formative Assessment**	**Docu ment**	**Live course**
Projection-based interaction interface for HRC	x								x	
Depth-sensor safety model for HRC	x								x	
Wearable AR-based interaction interface for HRC	x								x	
Kinesthetic teaching of robot skills					x					
ROS peripheral interface			x							
SMACHA Scripting Engine for Task Execution Control			x		x					x
MTM Universal Analysis System (UAS)		x	x		x				x	

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Delivery Mechanisms / Modules	Video /Tutorial	Presentation	Work shops	Virtual classroom	On Site: Seminar / Workshop / Conference / Lecture	Quiz	Q& A	Innovative Formative Assessment	Docu ment	Live course
Queued Message Handler (QMH) software architecture		x	x				x			
Robotino® communication		x	x				x			
Environment detection		x	x				x			
Mobile robot motion control		x	x				x			
Dynamic task planning & work re-organization	x	x			x	x		x	x	
AR based Operator support in HRC		x		x	x				x	x
Safety logic for seamless HRC	x	x							x	x
Safe human detection in a collaborative work cell	x	x							x	
Dynamic online trajectories generation for industrial robot with 3D camera	x	x							x	
Dynamic robot trajectory generation based on information from 3D-camera	x	x							x	
Robot trajectory generation based on digital design content	x	x							x	
IIoT Network Device Positioning			x		x					x
Real-time simulation for industrial robot	x	x							x	
Remote control for industrial robot	x	x							x	
Virtualization of a robot cell with a real controller										
UWB based indoor localization		x							x	
Object Detection	x								x	
Object Classification									x	
Robot Control for bin-picking	x	x							x	
EDI WSN/IoT TestBed	x	x							x	
Handling and Assembly Module									x	
Vision System / Quality Assurance									x	
User-Friendly Human-Robot Collaborative Tasks Programming	x	x							x	

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2.1 Academic and industrial Practices Review

In order to for first-time users to successfully develop new algorithms and products it was required to create some methods for transferring the knowledge from technology exports to new researchers. Over the last few years different methods for transferring the education material have been identified. The most common delivery mechanism is a text document introducing the knowledge which is scheduled to be transferred though this delivery mechanism. As presented in [1] and [2], one of the most powerful method for transferring the knowledge is by using tutorials. First-time users are introduced step-by-step into a new technology through a paradigm tested by this technology's expert developer. Presentations may be another type of delivery mechanism used for knowledge transfer [3][4]. The most widely used type of delivery mechanism over the web is the Q&A method. A big number of webpages and software distributor online services (Github, Bitbucket etc.) based on question and answer methods for the knowledge exchange between their customers. A quiz-based method for the deep learning of new technologies is presented in [5]. Entering the Industry4.0 era, two types of delivery mechanisms have been introduced. The first method based on the Augmented reality technology [6]. The second method is a hologram-based delivery mechanism which is presented in [7]. A learning method based on an innovative formative assessment strategy is presented in [8]. Another efficient delivery mechanism based on the directly communication of humans either physically by participating in scientific conferences and workshops [9] or over the web.

Based on the type of the webinar this delivery mechanism will be either a virtual classroom [10] [11] with several first-time users learn the new technology or a live course [12] where first-time users get to know a new technology though online courses. There are a number of virtual sessions using technology enhanced learning including multimedia technology. Experience has shown that training based on a Web-based is an effective approach. This concept may be significantly more effective than traditional programs with plenary sessions only or with virtual content only. In the following sections, the delivery mechanisms which will be used for each TRINITY module are presented in the following sections of this deliverable.

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3 Competence needs

3.1 TRINITY survey

The survey was designed with the intention of mapping the training needs of respective industrial users/stakeholders. Through the survey, the consortium aims to identify the competence needed to satisfy the industry and enable a match between the industries' needs and the TRINITY Internal demonstrators. Moreover, the survey aims to identify the training provider for the respective needs.

Each of the technology providing TRINITY partners have through workshops, seminars, meetings, etc. collected competence demanded by the industry. Based on the competencies provided each responsible partner will identify the education and training required by the users. All the information regarding the identified competence needs and the mapping to TRINITY modules has been integrated under a common document "TRINITY partner survey on "analysis and prioritization of training needs".

Through the TRINITY survey, over 60 competence needs were collected by all the technology providing TRINITY partners (total of 11), as also from Partner's communication and from feedback that they received from external companies has been additionally considered. These consisted of multiple overlying topics and thus, 51 distinctive competence needs were identified. Out of these, 40 competencies had been identified as ones that TRINITY partners can provide through the project. All competencies are based on the industries' needs and are cataloged into nine main categories together with a 10th category with topics unrelated to the main categories. Additionally, the survey specifies the type of users/stakeholders, material form to be used in the training and requirement for further development. The TRINITY survey reveals both a broad-spectrum and a significant alignment of competencies demanded by the industries. Hence, the survey scores the competencies depending on the popularity of the industries feedback. A higher score translates to greater need. Each of the competencies requires at least one consortium member as a provider, consequently, the competencies contain one lead partner and information about additional partners suitable to be a provider. Which means every partner needs to provide for 4-5 competencies each.

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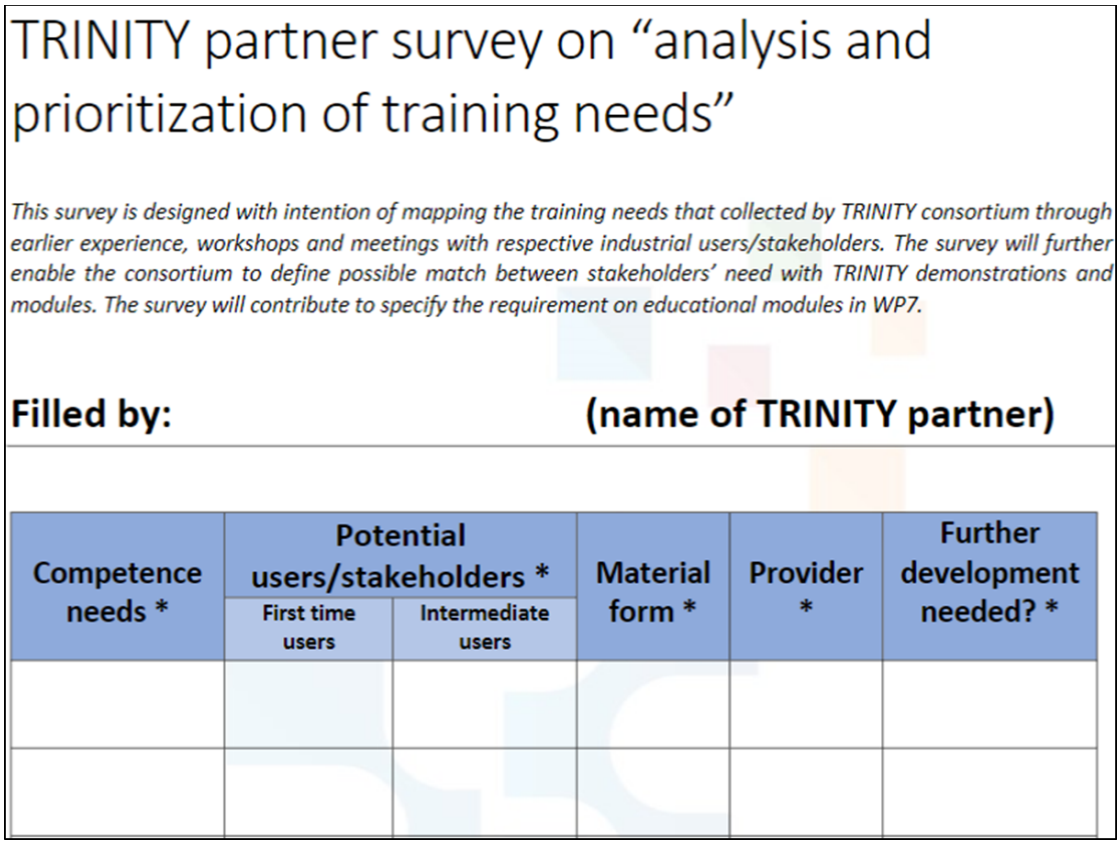

TRINITY partner survey on "analysis and prioritization of training needs"

This survey is designed with intention of mapping the training needs that collected by TRINITY consortium through earlier experience, workshops and meetings with respective industrial users/stakeholders. The survey will further enable the consortium to define possible match between stakeholders' need with TRINITY demonstrations and modules. The survey will contribute to specify the requirement on educational modules in WP7.

Filled by: **(name of TRINITY partner)**

Competence needs *	Potential users/stakeholders *		Material form *	Provider *	Further development needed? *
	First time users	Intermediate users			

Figure 3 TRINITY Partner survey Template

Task 7.1 was led by UIT supported by LMS through M07 – M12 of the project. All the technology-providing partners have provided feedback and input through the circulation of the survey and through the regular meetings occurring every other week.

3.2 TRINITY modules mapped to the relevant competences needs

At the table below the TRINITY Modules owners connect the identified competence needs with their modules so to facilitate how the participants will and how will be able to cover their needs. Several of them are covered from more than one TRINITY Modules. In these cases, the module owners will collaborate to prepare and combine their material in order to satisfy these.

Table 2 Mapping of needs and available modules

Competences and Needs	**Modules to cover Competence Needs**
Robotic programming	
Easy robot programming	Kinesthetic teaching of robot skills SMACHA Scripting Engine for Task Execution Control User-friendly human-robot collaborative tasks programming
Robot manipulators: Control and programming	**Remote control for industrial robot** UC16 Handling and Assembly Module User-friendly human-robot collaborative tasks programming
Computer vision: Sensors and programming	UC16 Vision System / Quality Assurance

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User-Friendly (re) programming of robots	**Remote control for industrial robot** Kinesthetic teaching of robot skills, SMACHA Scripting Engine for Task Execution Control
Program development in LabVIEW™ graphical programming language	Environment detection, Mobile robot motion control, Robotino® communication
Software architectures in LabVIEW™ graphical programming language	Queued Message Handler (QMH) software architecture
Human robot collaboration	
MTM workplace to obtain ergonomic work with matching time between human and automated tasks	UC16 MTM Universal Analysis System (UAS)
Collaborative robotics utilization in agile production	Safe human detection in a collaborative work cell User-friendly human-robot collaborative tasks programming Deployment of mobile robots in collaborative work cell for assembly of product variants
Smart tools for supporting human operators in human robot collaborative environments	Deployment of mobile robots in collaborative work cell for assembly of product variants User-friendly human-robot collaborative tasks programming
User friendly module for operators support in HRC Environment	User-friendly human-robot collaborative tasks programming
Human Robot communication channel for tasks reallocation in HRC environment	**Dynamic task planning & work re-organization Module**, Dynamic online trajectories generation for industrial robot with 3D camera
Task planning in HRC environment	**Dynamic task planning & work re-organization Module**
Automated guided vehicles (AGVs)	
Mobile robot utilization for indoor logistics	Mobile robot motion control Deployment of mobile robots in collaborative work cell for assembly of product variants UWB based indoor localization
Indoor localization of Mobile robots using UWB	UWB based indoor localization
UWB for tracking of the environment	UWB based indoor localization
Mobile manipulators for industrial applications	Deployment of mobile robots in collaborative work cell for assembly of product variants
Mobile robot programming	Mobile robot motion control Robotino® communication
Usage of different individual sensors and sensor system in mobile robots	Environment detection
Robot safety and security measures	
Cyber security	IIoT Network Fallback Simulation
For reviewing security aspects continuously	IIoT Network Fallback Simulation
For identifying security-relevant and – risky processes	IIoT Network Fallback Simulation
ROS	

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State machine programming (SMACHA)	SMACHA Scripting Engine for Task Execution Control
Simulation	
Decision/management tool (Visual component, VR robotics, ROS Moveit)	Real-time simulation for industrial robot (Does not include ROS MoveIt)
Augmented reality and Virtual reality	Robot trajectory generation based on digital design content
Advanced robot simulation	Robot trajectory generation based on digital design content
Robotic cell development	
Robotic workcell deployment	ROS peripheral interface
Robot cell hardware configuration	ROS peripheral interface
Cell module development	ROS peripheral interface
IoT, IIoT	
Connecting machines, sensors robots together	WSN/IoT TestBed
5G utilization in production	IIoT Network Device Positioning
Connected to TRL 3 or TRL 8	WSN/IoT TestBed
Digital Twin	
Real time control	**Remote control for industrial robot** Robot trajectory generation based on digital design content
Remote monitoring tool	**Real-time simulation for industrial robot**
Others	
Task planning in hybrid assembly cells	Dynamic task planning & work re-organization
Agile Manufacturing – Industry4.0	Deployment of mobile robots in collaborative work cell for assembly of product variants
Hardware technologies	UWB based indoor localization
Smart system for execution monitoring and coordination	AR based Operator support in HRC
Bin-picking principles (including industrial robot hardware, software planning and computer vision)	Robot control for bin picking Object detection
HPC usage for AI training	EDI - Object detection
MTM methodology	**MTM Universal Analysis System (UAS) Module**

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3.3 Other Identified Industrial needs

In this section has been specified the needs from the industry that have been identified but TRINITY DIH is not able to address cannot address due to time, budget, expertise and focus of the project.

These are:

- Custom, PLC, ROS2
- Robot Awareness training
- For coping with the heterogeneity of different and various data sources in the factory: machines, robots, sensors
- Hybrid manufacturing (3D printing) with metal SLM, FDM and TIG welding
- Architecture knowledge,
- Move IT
- Safety planning (production environment)
- MTM workplace to obtain economic work with matching time between human and automated tasks
- HRI safety regulation

One of the goals of the network is the upcoming years to be able to cover also these need and transfer education and knowledge also for them.

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4 TRINITY Training material and delivery mechanisms definition

The training material for the TRINITY training material is structured around a number of aspects which are described in the Table 3.

Table 3 Description of the main aspects of TRINITY Material

ASPECT	Description
Introduction	It allows having an idea about the training module but without too many details. This can be sufficient for a first appreciation and showing interest.
TRINIRY Pillars	Trinity aspects related to the module.
Key User/Stakeholder	Who will be the main user of the TRINITY training material for the module
Delivery Mechanism - ICT Level	This will be the ICT level of the technology that will be used for the training material. Low is considered if the delivery mechanism for the TRINITY Training material will be only ppt and document. Medium is considered the Video Tutorials, Live course etc. High is considered the Game based training, virtual reality environments, and web-based interactive multi-media.
Objectives	What is aimed to improve for the candidate through the training module. (skills, competences, etc.)
Content Description	Brief description of content of the module in terms of its main training units
Training type	Type of delivery mechanism of training module.

The next table is the template for the outline and a short description of the main characteristics of the TRINITY Training Material **Table 3**. The **Table 4** specifies a description of the main aspects of TRINITY Training Material outline.

Table 4 TRINITY Training Material Outline – Template

Introduction				
It allows having an idea about the training module but without too many details. This can be sufficient for a first appreciation and showing interest.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	**Digital tools and platforms, IIot**		**Data, System and Cyber security**	
Key User/Stakeholder				
University/Research Institute/student	**Manufacturing SMEs**	**Technology Provider/system integrators**	**End Users**	**Engineers/IT Personnel**
Delivery Mechanism - ICT Level:				
High	**Medium**		**Low**	
Requirements				
What the user should do know before the training.				
Objectives (*What is aimed to improve for the participant through the training module*)				
What is aimed to improve for the candidate through the training module? **What will learn from these trainings?** **What skills will you develop?** **What competences will the user develop?**				
Content Description				
(Brief description of content of the module in terms of its main training units) **Short description**				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	**Presentation**	**Virtual Reality Environments**	**Virtual classroom**	**On Site: Seminar / Workshop / Conference/ Lecture**

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Quiz	Q&A	Innovative Formative Assessment	Document	Live course

In the following sub-sections the training material template has been instantiated for each of the TRINITY modules

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4.1 Projection-based interaction interface for HRC – Provided by TAU

Introduction				
Projection-based interface for safe human-robot collaboration (HRC). The interface augments a workspace with virtual user-interface components (buttons, info bars safety hull etc.) that are monitored by a depth sensor.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
The participant should be familiarized with ROS and Python.				
Objectives (*What is aimed to improve for the participant through the training module*)				
Through the training the participant will learn how to use the projector-based support module and be familiarized with the technology and applications. In particular, the participant will learn how to utilize projector- and camera-based technology in a collaborative task where the human and robot together do a diesel motor assembly. The participant will learn the skills to set up the projector-camera support system for assembly tasks. He/she will be familiarized with tools and libraries that are required to successfully operate the system. The user will be familiarized how to create simple UI components and projected them in the shared environment on flat surfaces (e.g. tables, floors). The participant will be teached how projector, robot and camera system can be calibrated. In addition, the user will learn how to create and project dynamic safety hull around the robot that changes its shape based on the robot operations. Participants get an opportunity to develop AR-based solution that supports the human operator during a collaborative task by augmenting the shared workspace with virtual information. Based on reasearch outputs, the AR-based support can increase the feeling of safety and ergonomics of the human co-worker.				
Content Description				
The training would consist of the following units: Document: Introduction to projector- and camera-based technology in HRC; installation guide for needed software libraries and tools Video: Step-by-step video presentation to use the module Tutorial: Code examples related to the module				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.2 Depth-sensor safety model for HRC - Provided by TAU

Introduction

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Depth-based safety model for HRC that ensures safe interaction between the human and robot. The model establishes virtual 3D dynamic zones in the shared workspace that are monitored and updated using a single depth sensor.

TRINITY Pillars (Trinity aspect related to the module)		
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel

Delivery Mechanism - ICT Level:		
High	Medium	Low

Requirements
Basic knowledge of ROS, C++ and Python programming is required

Objectives (*What is aimed to improve for the participant through the training module*)
Through the training the participant will learn how to use the depth-based safety module. The participant will learn what is the safety zone concept in HRC and how they can be utilized to prevent collision between a human and robot. The participant will learn the skills to set up the depth-based safety module. He/she will be familiarized with tools and libraries that are required to successfully operate the module. The training material will teach the user how to establish dynamic zones which separate the shared workspace to different regions. The user will learn how to monitor these regions and what are their safety properties. In addition, the user will learn how to operate depth sensors in ROS framework and how we can visualize various data in ROS visualizer. Participants get an opportunity to test the depth-based safety module that ensures safe interaction between the human and robot in a collaborative task.

Content Description
The training would consist of the following units: Document: Introduction to safety zones in HRC; installation guide for needed software libraries and tools; introduction to depth sensors and point cloud-based processing. Video: Step-by-step video presentation to use the module. Tutorial: Code examples related to the module.

Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.3 Wearable AR-based interaction interface for HRC - Provided by TAU

Introduction
Wearable AR-based interface provides user-interface to instruct and inform the human operator in complex tasks by augmented the environment with 3D information. The training material focuses on head-mounted display Microsoft Hololens.
TRINITY Pillars (Trinity aspect related to the module)

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Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Basic knowledge of C#, Microsoft Visual Studio, Python				
Objectives (*What is aimed to improve for the participant through the training module*)				
Through the training the participant will learn how to use the wearable AR-based support module and be familiarized with the technology and applications. In particular, the participant will learn how to utilize Microsoft HoloLens in a collaborative task where the human and robot together do a diesel motor assembly. The participant will learn the skills to set up the Hololens-based support system for assembly tasks. He/she will be familiarized with tools and libraries that are required to successfully operate the headset. After the participant has completed the Mixed Reality Academy tutorials from Microsoft, he/she will know the basic the basic features and concepts of the head-mounted devices. In particular, the participant knows how to create software using Unity 3D editor and deploy them to Hololens. The participant will learn how the headset can be calibrated with a robot and how the communication is handled between a PC, robot and the headset during the assembly task. Participants get an opportunity to develop AR-based solution that supports the human operator during a collaborative task by augmenting the shared workspace with virtual information. Based on research outputs, the AR-based support can increase the feeling of safety and ergonomics of the human co-worker.				
Content Description				
Document: Introduction to AR-based interaction in HRC; installation guide for needed software libraries and tools Tutorials: Open source sample apps from Mixed Reality Academy; code examples related to the module. Video: Step-by-step video presentation to use the module				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.4 Kinesthetic teaching of robot skills

Introduction
Kinesthetic guidance provides an intuitive approach and quick approach to teach new robot skills. Instead of using classic robot programming approaches that involve interfacing with complicated user interfaces, the users can interact with the robot directly by physically interacting with it.
TRINIRY Pillars (Trinity aspect related to the module)

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Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel

Delivery Mechanism - ICT Level:		
High	Medium	Low

Requirements

Basic knowledge industrial robots handling.

Objectives (*What is aimed to improve for the participant through the training module)*

The candidates taking part in this training would learn how to use the kinesthetic guidance to teach robots new automation skills. Additional hardware and software components were developed to facilitate skill acquisition that the candidates need to familiarize with. Additionally, some best practices will be shared with the candidates from experts. Throughout the training the candidates will gain all the necessary knowledge independently kinesthetically acquire robot skills.

The training would be conducted with a hands-on approach where candidates would interact with the robot and the interfaces for kinesthetic teaching of robot skills. A dummy manufacturing process will be used as an example and the candidates will be shown how to teach the robot assembly skills.

By the end of the workshop, the candidates would learn how to teach robots new skills by kinesthetically interact with them and how to used the programs that facilitate this process. Our aim is that after this workshop the candidates would have enough knowledge on the matter to perform these tasks independently.

Content Description

The training would consist of the following units:

- Kinesthetically guide the robot around its workspace
- Use the robot's button interface to store poses or whole trajectories thought via kinesthetic guidance
- Use the graphical user interface to store this data into the MongoDB database
- Move the robot to the saved points by using different trajectory generation algorithms

Training type- Delivery mechanisms (*Type of delivery of training module*)

Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.5 ROS peripheral interface – Provided by JSI

Introduction

The Robot Operating System (ROS) is a framework of tools, libraries and conventions that facilitate the development of robotic applications and integration of new hardware. The latter can sometimes be cumbersome because the already present peripheral hardware in a manufacturing might not be ROS-

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ready. In this workshop we will present how to integrate such hardware into the ROS software architecture by using a simple micro-computer to communicate with said hardware.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Basic knowledge of industrial automation if required.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The attendees of this workshop will learn how to use the ROS peripheral interface and how to adjust it to different types of peripheral equipment. The goal of this workshop is to provide the attendees with the knowledge required to independently develop new ROS peripheral interfaces on their own according to their needs. The attendees will learn how to find information that will help them establish a communication channel between the existing peripheral equipment and the ROS peripheral interface. Through an example they will also learn the how to connect various wires and signals of different voltage levels to the micro-computer running the ROS nodes. Additionally, know-how and good practices will be shared from the organizers of the workshops to the attendees.				
Content Description				
The training would consist of the following units: • Prepare an SD card with the Linux image with ROS preinstalled • Configuring the micro-computer and connecting it to the ROS network • Explanation of the wiring diagram of the micro-computer • How to connect digital signals with different voltage levels				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.6 SMACHA Scripting Engine for Task Execution Control – Provided by JSI

Introduction		
SMACHA is a framework for writing complex state machines in a simple YAML based script.		
TRINIRY Pillars (Trinity aspect related to the module)		
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

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Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High		Medium		Low
Requirements				
Deep understanding of the ROS architecture as well as Python programming language.				
Objectives (*What is aimed to improve for the participant through the training module*)				
SMACH is an exceptionally useful and comprehensive task-level architecture for state machine construction in ROS-based robot control systems. However, while it provides much in terms of power and flexibility, its overall task-level simplicity can often be obfuscated at the script-level by boilerplate code, intricate structure and lack of code reuse between state machine prototypes. SMACHA (short for "State Machine Assembler", pronounced "smasha") aims at distilling the task-level simplicity of SMACH into compact YAML scripts in the foreground, while retaining all of its power and flexibility in Jinja2-based templates and a custom code generation engine in the background. Thus SMACHA does not aim to replace SMACH, but to augment it.				
Content Description				
The training would consist of the following units: • Introduction to the basic concept of SMACH • Explanation of the SMACHA framework • Creating an example SMACHA script that interacts with a simulated robot • Introduction to writing Jinja2 templates • Introduction to the SMACHA ROS server and how load templates and scripts to the ROS parameter serve				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.7 MTM Universal Analysis System (UAS) – Provided by IWU,LP

Introduction		
System of predetermined time units to calculate the manual effort of the human in production environments. MTM (Methods-Time Measurement) is a procedure for analysing work processes and determining planned times.		
TRINITY Pillars (Trinity aspect related to the module)		
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

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Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel

Delivery Mechanism - ICT Level:		
High	Medium	Low

Requirements

The user should have basic skills in process planning processes and work preparation

Objectives (*What is aimed to improve for the participant through the training module)*

Through the training for the MTM-UAS module the participant will be informed that this tool is ideal to create work processes to achieve high benefit and to eliminate waste already in the planning phase.
The participant learns that MTM finds its justification especially in the planning processes. To create an analysis only knowledge about the structure of the work system as well as an idea of the planned work processes are necessary. It is not necessary to find an existing process or workplace for the application of the MTM method like it is required in contrast to the time recording by means of a stopwatch (REFA).
User will learn following:

- Why due to the use of MTM (UAS), workplaces can be ergonomically designed and ensure that work does not make the worker / employee sick
- The smallest movement elements are recorded in MTM-methods, in which the main workflow is divided into basic motion elements, the so-called MTM control loop. The basic movements of the control loop are "reach", "grasp", "bring", "place" and "release", supplemented by moving elements such as "walking", " bend over and straighten up", "visual control", “handling tools” etc.
- Due to the worldwide uniform coding of the movement elements, MTM is valid worldwide and is understood by all trained employees
- Distinction of detectable and non-detectable activities by MTM-method
- Advantage of primary and secondary analysis when using MTM to get information about the efficiency of a production system

Caution: the training module does not substitute an education at the MTM Association. The module is only to be understood as an introduction to the basics and the advantages of the MTM method

The users will improve knowledge of ergonomics and economy during the planning phase of manual or hybrid workplaces. Taking into account the possibility of assignment, e.g. assembly tasks on humans and robots, without creating waiting times for humans.
Participants will get an opportunity to develop competencies in knowledge of MTM-UAS as an objective time management toll.
The competence for the general understanding in the area of ergonomic and thus economical manual and hybrid work system design will be developed.

Content Description

Document: Guide for general objectives of use of MTM
Presentation: Presentation with the problem description, the needs that this module satisfies and training methodology description
Workshop: Introducing MTM as an appropriate calculation tool of time management with the possibility of deriving primary and secondary parts from the total effort and thus determining the efficiency of a work system
On site – Lecture: Basic information about history, development and advantage of MTM as a time management calculation tool and guidelines for implementation and use of the module based on selected examples

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Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.8 Queued Message Handler (QMH) software architecture – Provided by BME

Introduction				
The goals of this training material are to teach the user the advanced software architectures, how to choose and implement an applicable software architecture for controlling a mobile robot in LabVIEW™ graphical programming language.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
Basic understanding of LabVIEW™ graphical programming language.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The training aims to present the difficulties and best practices of large scale software development through case studies and applications within the field of mobile robot programming in LabVIEW™ graphical programming language in a hands-on approach. Attendees of the training can learn why advanced software architectures are a necessity for large scale software development. Attendees can learn the types of advanced software architectures and which one to use and how to implement them in different application scenarios. Attendees of the training can develop the following skills: LabVIEW Programming, mobile robot programming. The user, after the training, will be able to develop large scale software in LabVIEW™ graphical programming language to control mobile robots.				
Content Description				
Presentation of the difficulties and best practices of large scale software development. Workshop: hands-on lessons on implementing advanced software architectures. Discussion after every lesson.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop /

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				Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.9 Robotino® communication – Provided by BME

Introduction				
The goal of this training material is to show the user through an example application the full scale of capabilities of LabVIEW™ graphical programming language for communication on the local network from a low level to the protocol level in a mobile robot control scenario.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Basic understanding of LabVIEW™ graphical programming language.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The training aims to present the capabilities of LabVIEW™ graphical programming language for communication on the local network through case studies and applications. The focus is kept on the control of a mobile robot. Attendees will learn how to implement communication protocols to communicate between devices on the local network. Attendees will also learn the best practices on how to integrate communication algorithms as software components (modules) into a complex application. Attendees of the training can develop the following skills: UDP communication, TCP/IP communication. The user, after the training, will be able to develop and implement communication algorithms as standalone software or as software module.				
Content Description				
Presentation of capabilities of LabVIEW™ graphical programming language for communication on the local network. Workshop: hands-on lessons on each supported communication protocol. Discussion after every lesson.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.10 Environment detection – Provided by BME

Introduction				
The goal of this training material is to show the user through an example application on how to select and use appropriate sensors and sensor systems to control a mobile robot in LabVIEW™ graphical programming language.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Basic understanding of LabVIEW™ graphical programming language.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The training aims to present the possibilities of environment detection with the use of on-board sensors of a mobile robot (RGB camera, optical proximity switch, IR distance sensor, and others) to implement measurement and analysis algorithms. Attendees will learn the basic working principles of the often-used sensors in mobile robotics and the best practices on how to implement analysis algorithms. Attendees of the training can develop the following skills: knowledge of sensors used in mobile robotics. The user, after the training, will be able to choose and apply the appropriate sensor type for a specific environment detection problem.				
Content Description				
Presentation of the often-used sensors in mobile robotics. Workshop: hands-on lessons on the best practices on how to implement analysis algorithms for the often-used sensors in mobile robotics. Discussion after every lesson.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.11 Mobile robot motion control – Provided by BME

Introduction				
The goal of this training material is to show the user through an application example on how to develop and implement open-loop and closed-loop motion control algorithms in LabVIEW™ graphical programming language in a mobile robot control scenario.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
Basic understanding of LabVIEW™ graphical programming language.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The training aims to present the basic principles and usage of open-loop and closed-loop motion control of a mobile robot. Open-loop motion control algorithms will be implemented as time-controlled motion patterns, and closed-loop motion control algorithms will be based on the data provided by the on-board sensors of the mobile robot. Attendees will learn the basic principles and implementations of open-loop and closed-loop motion control algorithms. Attendees of the training can develop the following skills: open-loop motion control, closed-loop motion control. The user, after the training, will be able to develop software algorithms for open-loop and closed-loop motion control.				
Content Description				
Presentation of the theory of open-loop and closed-loop motion control. Workshop: hands-on lessons on implementing open-loop and closed-loop motion control algorithms. Discussion after every lesson.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.12 Dynamic task planning & work re-organization – Provided by LMS

Introduction				
In order to overcome the time-consuming process of designing a new human-robot process and reduce the time and size of the design team needed for applying a change to an existing assembly line, this module suggests a decision-making algorithm enabling the automatic line reconfiguration considering concurrently the task planning issues				
TRINITY Pillars				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Technology level of the Training material:				
High	Medium		Low	
Requirements				
The participant should be familiarized with SQL and Java.				
Objectives				
Through the training for the Dynamic task planning & work re organization module the participant will be exercised in the generation of a schedule depending on a set of assignment criteria. Also, the users will be able to have dynamic distribution of activities that will be carried out to every relevant resource (e.g. robot or human). Last will be familiarized with graphical modelling of a manufacturing process following the described breakdown of tasks, jobs etc. The module will deliver a game-based collaboration & group decision-making exercise on the basis of a specially designed scenario for the generation and assessment of alternative job rotation schedules. It will offer basic knowledge about digital human simulation, process ergonomics analysis, workplace design, human process design and redesign / Application in the automotive industry. He / She will learn about integrated manufacturing management tasks like planning, scheduling and evaluation of manufacturing processes and facilities. He / She will learn how to increase a factory's productivity, efficiency and quality. The module will explain and illustrate the new manufacturing solutions in task allocation and dynamic work re-organization. The module will also highlight how the real-time field data can be collected and information can be used for the decision support systems. The module will show hands-on practice with running & testing some real life – like scenarios using the custom-made software tool and the use of Computer Based Training tools in a multiple user web-based platforms, simulation engines, etc. Participants will get an opportunity to develop competencies in simulating manufacturing processes. The competence to reduce of a job's mean flow time and the enabling of a human - robot collaboration by bringing the human closer to the robotic understanding.				
Content Description				
Document: Guide for installation of Siemens Process simulate, Java and SQL Presentation: Presentation with the problem description, the needs that this module satisfies and training methodology description Video-Presentation: Introducing job rotation and dynamic scheduling concepts, representing an assembly line on a hierarchical structure Video: The thematic content of the video is to explain and guide the operator to the module environment.				

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Video Tutorial: A tutorial with the steps to build the layout of the work cell – the video will be based in of the Use case demonstrators as an example. Webinar: The content of the webinar is a demo of the module based on the real scenario using multiple criteria decision making algorithms for the evaluation of the alternatives according to a set of user defined criteria. On site – Lecture: Guidelines for implementation and use of the module Innovative Formative Assessment: A test of relevant and meaningful learning. When participants learn something they find useful, they're likely to want to use that learning in some way. Have participants end the training with this one. 3 things you didn't know before 2 things that surprised you about this topic 1 thing you want to start doing with what you've learned (You can also ask them different kinds of questions, these are suggestions)

Training type:				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.13 AR based Operator support in HRC – Provided by LMS

Introduction				
This module support the human operator through the AR Application, in order to be aware of the execution status of every operation.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The participant should understand programming languages and be familiarized with Open source software tools.				
Objectives (*What is aimed to improve for the participant through the training module*)				
Through the training for the AR based operator support module the participant will be familiarized with the AR technology and applications, also the participant will learn to use smart devices like the AR glasses and smartwatch. Also, though this training the participant will feel more safe and confident				

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during human robot collaborative assembly tasks as he will be aware of the execution status of every operation.
The participant will learn to set up an AR operator support application for several assembly tasks. Present basic knowledge about smart devices, process ergonomics analysis, workplace design, human process design and redesign / Application in the automotive industry.

After this training the participant will be able during the operation to:

- Receive information for each production step more easily and quickly through virtual demonstrations, videos and images
- Easy robot Programming
- The participant will be able to reset robot in Emergency states
- Receive visual and audio warning messages
- Visualize safety areas and robot's trajectory stemming from robot's controller
- Acquire information on the shop floor status and the upcoming products increasing operator's awareness and response in a non-intrusive way

Participants will get an opportunity to develop AR solution that supports the operators in the assembly process, by providing immersive assembly instructions in their field of view along with production data when needed.

The competence to get production and process related information as well as to enhance the operators' immersion in the safety mechanisms, dictated by the collaborative workspace.

Content Description

Document: Introduction to AR approach and AR manufacturing applications as is the assembly planning, assembly guidance and product design
Presentation: Presentation with the problem description, the needs that this module satisfies and training methodology description
Video-Presentation: The thematic content of the video is to explain and guide the operator to the module environment.
Live course: The content of the webinar is a presentation of the application of AR technologies in manufacturing industry.
A demo of the module based on real scenario
On site – Lecture: Guidelines for implementation and use of the module

Training type- Delivery mechanisms (*Type of delivery of training module*)

Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.14 Safety logic for seamless HRC – Provided by LMS

Introduction				
This module refers to the safety architecture that has been implemented and includes all the safety certified technologies used to ensure human safety inside the collaborative cell. The layout of the cell has been regulated in accordance with the implemented safety systems.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The participant should be familiarized with Safety eye configurator software Hardware needed: Safety eye sensing devise, Safety PLCs, Analysis unit, Emergency buttons				
Objectives(*What is aimed to improve for the participant through the training module*)				
Through the training for the Safety logic for seamless HRC module the participant will be exercised in designing safety zone arrangements, offline, suitable for any kind of workspace. He / She will receive basic knowledge on safety systems. He /She will learn how to calculate the geometrical shapes of the Safety zones to be designed based on ISO/TS 15066. He / She will learn how to increase a factory's productivity and efficiency. The module will show examples of safer and more efficient Human-Robot interaction and use of fenceless robotic cells. Hands-on practice with safety zones designing using the software tool. Participants will get an opportunity to develop competencies in designing Safety zones. The competence to reduce of a job's mean flow time by enabling a more efficient human - robot collaboration.				
Content Description				
Document: Guide for installation the needed hardware and the Safety eye configurator software. Presentation: Presentation with the problem description, the needs that this module satisfies and training methodology description. Video: The thematic content of the video is to explain and guide the operator to the module environment. Live course: A course with the steps to design the Safety zones on the work cell – the video will be based in of the Use case demonstrators as an example.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.15 Safe human detection in a collaborative work cell – Provided by CENTRIA

Introduction				
Safe human detection in a collaborative work cell. Module provides capabilities to detect human workers in robot working cell. This way human workers and robots can safely work together in collaborative tasks ie. assembly.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Participants should have basic ICT and electrical skills				
Objectives(*What is aimed to improve for the participant through the training module*)				
During training participants will learn how to install, configure and connect safety scanners and safety cameras. They will also learn how to define safety areas and how to plan physical locations of safety scanners and cameras. Training material consists of documents of safety devices and robots. Students can learn by themselves with documentations provided. By the end of this training user has basic knowledge of safety scanners and cameras. They will also know how to select suitable one, and also install and configure this device.				
Content Description				
Training consist of following topics: • Introduction to safety scanners and cameras • Locating and installing of device • Interfacing with robot controller • Configuring of safety areas				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.16 Dynamic online trajectories generation for industrial robot with 3D camera – Provided by CENTRIA

Introduction				
Dynamic online trajectories generation for industrial robot with 3D-camera. Module offers possibility to generate robot trajectories dynamically based on physical conditions inside robot work cell.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Participants should have Basic ROS and C++ programming knowledge				
Objectives (*What is aimed to improve for the participant through the training module*)				
During training participants will learn how to install and configure depth camera for use with ROS. They will also gain knowledge of utilizing this depth map of work cell in ROS to control robot based on this real-time information. Training material consists of documents, videos and tutorials. Students can learn by themselves with material provided. By the end of this training user has basic knowledge of adding depth camera for ROS. They will also know how to select suitable device, install, configure and control robot movements based on information from device.				
Content Description				
Training consist of following topics: • Introduction to 3D-cameras and ROS • Locating and installing of device • Interfacing camera with ROS • Configuring camera for ROS • Interfacing robot with ROS • Configuring robot for ROS				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.17 Dynamic robot trajectory generation based on information from 3D-camera – Provided by CENTRIA

Introduction				
Dynamic robot trajectory generation based on information from 3D-camera module provides possibility to create robot trajectories dynamically by scanning work objects with 3D-camera.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Participants should have advanced skills in robot simulation and basic knowledge of industrial robots				
Objectives(*What is aimed to improve for the participant through the training module*)				
During training participants will learn how to generate robot trajectories dynamically. Software used here is AUTOMAPPPS. Training material consists of documents, videos and tutorials. Students can learn by themselves with documentations provided. By the end of this training user has basic knowledge about dynamical creation of trajectories for robot using point cloud data.				
Content Description				
Training consist of following topics: • Introduction to point cloud data • Basics of AUTOMAPPPS • Importing point cloud data to AUTOMAPPPS • Creating trajectories for robot • Interfacing AUTOMAPPPS with robot				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.18 Robot trajectory generation based on digital design content – Provided by CENTRIA

Introduction				
Robot trajectory generation based on digital design content provides possibility to utilize information contained in digital design content on robot simulation. And also how this information can be utilized in AVR.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Participants should have basic skills in robot simulation and basic knowledge of industrial robots				
Objectives (*What is aimed to improve for the participant through the training module*)				
During training participants will learn how to generate robot trajectories with RoboDK software utilizing information contained in digital context. Also they will gain knowledge of possibilities how to use this information in AVR-experience. Training material consists of documents, videos and tutorials. Students can learn by themselves with documentations provided. By the end of this training user has basic knowledge about creation of trajectories for robot using data from digital context model and also using this information in AVR-experience.				
Content Description				
Training consist of following topics: • Introduction to BIM • Importing BIM to RoboDK • Generating trajectories for robot • Possibilities of utilizing BIM in AVR-experience				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.19 IIoT Network Device Positioning – Provided by IWU

Introduction				
The module "IIoT Network Device Positioning" provides our simulation environment d3vs1m for computing the optimal distribution of the network devices located inside a physical building. It takes a 3D model of the building and other additional properties of the wireless radio devices as input and simulates the behaviour. Depending on the simulation result an optimal distribution of the network devices is calculated.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
The participant should be familiar with: • Connecting and using REST endpoints • Wavefront OBJ model of the building				
Objectives (*What is aimed to improve for the participant through the training module*)				
This module provides a REST endpoint for computing the optimal distribution of wireless network devices located inside a physical building. For that purpose it is required to provide a Wavefront OBJ model of the building desired for computation. Through that course the participant will learn how to use the provided REST endpoint. It explains the required inputs and demonstrates the outcome to expect. It gives examples about how to use it as a programmer from scratch (on-premise). The participant will also learn how to use it in an example implementation. Furthermore, it is shown how to use this module as a service. For that purpose a live demonstration will be given with an example model from the Fraunhofer IWU.				
Content Description				
The training consists of the following aspects: • Basic introduction to the problem domain • Introduction to the basic architecture of *d3vs1m* • Demonstration of this module as-a-service in a live demonstration of our developed web application • Explanation of the REST endpoint (API) • Demonstration of source code in .NET and how this endpoint is used • Demonstration of how this endpoint can be used in other programming languages (such as Java) (optional) hands-on programming an example				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825196

4.20 IIoT Network Fallback Simulation – Provided by IWU

Introduction				
The module "IIoT Network Fallback Simulation" provides our simulation environment d3vs1m for simulating the wireless network behavior, realized with the module IIoT Network Device Positioning, and a selected cyber-attack scenario. It takes a 3D model of the building and other additional properties of the wireless radio devices as input and simulates the behavior. Depending on the simulation result the user gets the adapted network behavior.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
The participant should be familiar with: • Connecting and using REST endpoints • Wavefront OBJ model of the building • General understanding of cyber attacks				
Objectives (*What is aimed to improve for the participant through the training module*)				
The training consists of the following aspects: • Basic introduction to the problem domain • Basic introduction to potential cyber security risks and potential attacks • Introduction to the basic architecture of *d3vs1m* • Demonstration of this module as-a-service in a live demonstration of our developed web application • Explanation of the REST endpoint (API) • Demonstration of source code in .NET and how this endpoint is used • Demonstration of how this endpoint can be used in other programming languages (such as Java) (optional) hands-on programming an example				
Content Description				
The training consists of the following aspects: • Basic introduction to the problem domain • Basic introduction to potential cyber security risks and potential attacks • Introduction to the basic architecture of *d3vs1m* • Demonstration of this module as-a-service in a live demonstration of our developed web application • Explanation of the REST endpoint (API) • Demonstration of source code in .NET and how this endpoint is used • Demonstration of how this endpoint can be used in other programming languages (such as Java) (optional) hands-on programming an example				
Training type- Delivery mechanisms (*Type of delivery of training module*)				

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825196

Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.21 Real-time simulation for industrial robot – Provided by UiT

Introduction				
The module contains simulated robot/machine which constantly imitate the robot/machine in physical world in real-time. This allows for remote monitoring of the robot and 3D detection of the robot.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The user should be familiar with python and industrial simulation software				
Objectives (*What is aimed to improve for the participant through the training module*)				
This module shows how to connect industrial robot to robot information server (OPC UA server). What will learn from these trainings? The participant will learn how to imitate a robot in a simulation software through a robot information server. This enables remote monitoring of the robot and the simulation software can be used for offline testing of the robot. This module will make you more familiar with the robot joint information. The user will be able to use of simulation software (Visual Components) to design and recreate the physical space in the simulation model, use of OPC UA server to connect the simulation software (Visual Components) and the physical robot together, and collect historical data of the robots rotation.				
Content Description				
Presentation with the problem description, and the steps that is needed to complete the training. A video showing on how to connect the robot in Visual Components with the physical robot, and how recreate the physical world in Visual Components. Document:Short manual.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.22 Remote control for industrial robot – Provided by UiT

Introduction				
Remote control of an industrial robot with a simple GUI. The GUI allows for control of the robot joints and you can create simple control programs of the robot with the GUI.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The user should be familiar with python, industrial simulatIon software and industrial robot.				
Objectives (*What is aimed to improve for the participant through the training module*)				
The main aim of the module is to show how an industrial robot can be controlled remotely through a simple GUI instead of the teach pendant. The module will guide user to set up the GUI with the industrial robot and how to use it. Users will learn how to move the robot from point to point. After the training the user will be able to set up and use the GUI created.				
Content Description				
Presentation: A presentation will be created with the problem description, and it shows what the buttons do in the GUI Document: Short manual. Video/tutorial:Showing how to connect the GUI and how to control the robot. Video:Showing an example when the GUI is used with the KUKA robot.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.23 Virtualization of a robot cell with a real controller – Provided by Fastems

Introduction
The module consists of a virtual model and a real controller. The virtual model acts as the manufacturing hardware of the system and can be used to accurately visualize/simulate ongoing production activities within the system. This creates a safe and interactive learning/training environment for agile manufacturing.
TRINITY Pillars (Trinity aspect related to the module)

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Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
Basic knowledge of modern manufacturing systems and concepts is necessary				
Objectives (*What is aimed to improve for the participant through the training module*)				
The user will be able to use the MMS (Manufacturing Management Software) and understand the key principles of agile manufacturing and how the agile manufacturing cell functions. User will learn from these on how to use the MMS UI, how to manage production data with the MMS and how an agile robot cell works. The user will gain "hands-on" experience with the MMS and an agile manufacturing cell. After the training the user will be able to use the MMS to manage an agile manufacturing cell. They will also understand the concept of agile manufacturing.				
Content Description				
The training material will cover the basic functionalities of the MMS, the agile manufacturing cell and the required hardware. The basic functionalities include: -How to navigate the UI -How to create part & fixture master data -How to create or import production orders -How to manage the devices and tools of the system -How to create or import NC-programs -How to run production activities				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.24 UWB based indoor localization - Provided by Flanders Make

Introduction
The Localization module will generate a two-dimensional location, heading and angular velocities of the object being tracked in the world model using Ultra-Wideband (UWB) technology based on the IEEE 802.15.4a standard. The module will be compatible with off the shelf Decawave TREK1000 evaluation kit. It will localize independent of the localization capabilities indigenous to the mobile object. Therefore, it can also be added to any mobile platform without localization abilities or replace existing expensive other localization technologies, e.g. laser scanners.

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The localization system requires an accurate anchor placement configuration. This configuration indicates per anchor its position within the world frame. A maximum of 8 anchors and 8 tags will be supported.

TRINITY Pillars (Trinity aspect related to the module)		
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel

Delivery Mechanism - ICT Level:		
High	Medium	Low

Requirements
Basic Knowledge of Linux, ROS, Python

Objectives(*What is aimed to improve for the participant through the training module*)
The candidate will be able to use the localization module and acquire 2D pose readily through Decawave Evaluation kit TREK1000. This training will provide documentation on how to use the software package provided with the module to setup localization module. Software package includes Firmware for the UWB devices, ROS localization package, Visualization tools, Configuration tools Users will be able to use off the shelf UWB evaluation kits and apply it directly to real use cases. Users will develop competences in indoor localization and tracking of objects with high accuracy providing low-cost, efficient Indoor localization solution.

Content Description
The main content provided will consist of extensive documentation. The Documentation will cover the following aspects: 1. Manual for hardware setup and configuration 2. Manual for Firmware (re)programming 3. Description of ROS application for localization and data acquisition 4. Supporting tools for the module Supporting tools provided with the module • Flash firmware to the TREK1000 evaluation boards. • Calibration of different antenna configurations • (Re)program UWB firmware settings • Configuration & Monitoring Tools

Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.25 Object Detection – Provided by EDI

Introduction				
AI-based computer vision algorithms for arbitrary placed object detection that can be picked by an industrial robot				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
The user should be familiar with Python programming language and docker				
Objectives (*What is aimed to improve for the participant through the training module*)				
With this module user will learn on how to use and train CNN-based YOLO computer vision algorithms with synthetically generated data sets for randomly placed object detection. The users will gain knowledge and skill for using of CNN-based YOLO computer vision algorithms with synthetically generated data sets The after the training user will be able to use HPC for AI training and AI-based computer vision algorithms for object detection.				
Content Description				
Document: Guide of module setup steps, general objectives of use of module, detailed instructions Video/Tutorial: Tutorials showcasing the most common use cases of the module, synthetical data generation and AI training.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.26 Object Classification – Provided by EDI

Introduction		
A deep convolutional neural network (CNN) that used to classify and sort objects		
TRINITY Pillars (Trinity aspect related to the module)		
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security

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Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
The user should be familiar with Python programming language				
Objectives (*What is aimed to improve for the participant through the training module*)				
Users will learn from these trainings the basic knowledge about object classification using CNN? After this training the user will understand more about use of CNN for object classification The user after the training will be able to use object classification module to classify and sort different kind of objects				
Content Description				
Document: Guide of module setup steps, general objectives of use of module, detailed instructions.				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.27 Robot Control for bin-picking – Provided by EDI

Introduction				
Movement and trajectory creation depending on object position in the container, object class or other information from sensors.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot		Data, System and Cyber security	
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium		Low	
Requirements				
C++ programming language, Linux, ROS, basic robotics				
Objectives(*What is aimed to improve for the participant through the training module*)				
The users will learn about robot control together with different AI based computer vision systems, dynamic robot movement creation. Also they will become familiar with the MoveIt! Tool and library.				

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Users will learn the basic of ROS and MoveIt! Systems and robot control in dynamic environment, where pickable object positions are not structured The user after the training will be able to use MoveIt! with ROS for robot control for bin-picking use case.
Content Description
Document: Guide of module setup steps, general objectives of use of module, detailed instructions Video/Tutorial: Tutorials showcasing the most common use cases of the module
Training type- Delivery mechanisms (*Type of delivery of training module*)

Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.28 WSN/IoT TestBed – Provided by EDI

Introduction				
EDI WSN/IoT TestBed is located in EDI premises in Riga. EDI WSN/IoT TestBed consists of 2 parts: *1*. EDI Indoor WSN TestBed (100 nodes) and *2*. EDI mobile WSN TestBed (50 nodes. EDI indoor WSN TestBed is a 100+ node heterogeneous sensor network and wireless sensor network testbed distributed around 7 floor building for validation and research in sensor network & wireless network protocols.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
Basic understanding of WSN/IoT concepts and basic WSN/IoT programming skills. Knowledge of how to use shell.				
Objectives(*What is aimed to improve for the participant through the training module*)				
The users will get the basic knowledge about WSN and IoT developing and testing. This module will offer an overview and understanding of WSN/IoT testbed usage for developing and debugging capabilities. The user after the training will be able to use the EDI WSN/IoT TestBed at advanced level.				
Content Description				
Document: Guide for general objectives of use of EDI WSN/IoT TestBed as well as detailed instructions about the tools usage from practical perspective Presentation: Describe the needs that this module satisfies and training methodology description				

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Video/Tutorial: Short videos showcasing the most common use cases of the EDI WSN/IoT TestBed				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.29 Handling and Assembly Module – Provided by EDI

Introduction				
This module provides a guideline for gripping and handling of small parts, e.g. electronic components, with a universal usable robot gripper. To achieve this goal, the user of the guideline analyses interdependencies between factors such as component geometry, number of pieces, cycle times and so on. Furthermore, the module describes the process of choosing the right components for the robot to handle. The results of the analysis are the selection of a suited stand-alone robot, the design of the gripping tool and the plant layout including required safety equipment for the desired application.				
TRINIRY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The participant should be familiar with: • Basic knowledge of handling technology and plant design • The specifications of the components and of the production process				
Objectives (*What is aimed to improve for the participant through the training module*)				
The objective of this module is to create a guideline for the end user, which supports the process of realizing a gripping and handling task. The focus lies on handling small components. The participant will be able to conduct the steps needed in order to implement the desired handling application.				
Content Description				
The training consists of the following aspects: • Selection of robot • Selection of gripper • Selection of components that can be handled by the robot • Required safety equipment • Suggestions for plant layout				
Training type- Delivery mechanisms (*Type of delivery of training module*)				

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Video/Tutorial	Presentation	Workshops	Virtual Reality classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

4.30 Vision System / Quality Assurance – Provided by IWU

Introduction				
This module provides a guideline to select a suited vision system for optical quality assurance applications. It describes the selection process including all factors that have to be considered. This includes aspects such as component size and geometry, tolerances, time needed for data analysis, software interfaces and usability of control and evaluation software.				
TRINITY Pillars (Trinity aspect related to the module)				
Robotics, interaction/collaboration and system reconfiguration	Digital tools and platforms, IIot	Data, System and Cyber security		
Key User/Stakeholder				
University/Research Institute/student	Manufacturing SMEs	Technology Provider/system integrators	End Users	Engineers/IT Personnel
Delivery Mechanism - ICT Level:				
High	Medium	Low		
Requirements				
The participant should be familiar with: • Basic knowledge of vision systems • Basic knowledge of robotic programming (if it is used for robot path planning)				
Objectives(*What is aimed to improve for the participant through the training module*)				
This module will support the participant's process of selecting and implementing an appropriate vision system. The guideline gives an overview and an explanation of the factors, which have to be taken into account while selecting a vision system. The module discusses briefly possible camera arrangements.				
Content Description				
The training consists of the following aspects: • Selection of vision system • Implementation of vision system				
Training type- Delivery mechanisms (*Type of delivery of training module*)				
Video/Tutorial	Presentation	Workshops	Virtual Reality classroom	On Site: Seminar / Workshop / Conference/ Lecture
Quiz	Q&A	Innovative Formative Assessment	Document	Live course

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4.31 User-Friendly Human-Robot Collaborative Tasks Programming – Provided by IWU

<table>
<tr><td colspan="6">Introduction</td></tr>
<tr><td colspan="6">The module provides an interface for the operators to program, modify & execute robotic applications with an intuitive and interactive approach. The operator can program using a graphical interface or use speech to interact with the creation process or teach new trajectories to the robots using teach by demonstration. Once an application has been created, the operator can further modify it to better achieve the desired goal.</td></tr>
<tr><td colspan="6">TRINITY Pillars (Trinity aspect related to the module)</td></tr>
<tr><td colspan="2">Robotics, interaction/collaboration and system reconfiguration</td><td colspan="2">Digital tools and platforms, IIot</td><td colspan="2">Data, System and Cyber security</td></tr>
<tr><td colspan="6">Key User/Stakeholder</td></tr>
<tr><td>University/Research Institute/student</td><td>Manufacturing SMEs</td><td>Technology Provider/system integrators</td><td>End Users</td><td colspan="2">Engineers/IT Personnel</td></tr>
<tr><td colspan="6">Delivery Mechanism - ICT Level:</td></tr>
<tr><td colspan="2">High</td><td colspan="2">Medium</td><td colspan="2">Low</td></tr>
<tr><td colspan="6">Requirements</td></tr>
<tr><td colspan="6">Basic knowledge of operating computer systems</td></tr>
<tr><td colspan="6">Objectives (What is aimed to improve for the participant through the training module)</td></tr>
<tr><td colspan="6">The participants will learn an intuitive programming method for robots using this module allowing to quickly build robotic applications with ease and flexibility
This training will provide documentation on how to benefit from the module for programming robots in intuitive and flexible approach.
Users will develop skills to easily & intuitively create, modify & execute robotic applications.
Users will develop competences in (re)programming of robot applications</td></tr>
<tr><td colspan="6">Content Description</td></tr>
<tr><td colspan="6">The main content provided will consist of extensive documentation. The Documentation will cover the following aspects:
1. Setup of the easy programming module
2. How to launch and use the application GUI
3. Procedure for programming the robot using different HMIs
4. Complete manual of the module
Furthermore, a Video tutorial & Presentation will be provided summarizing the use of the module, its functionalities and advantages of the module.</td></tr>
<tr><td colspan="6">Training type- Delivery mechanisms (Type of delivery of training module)</td></tr>
<tr><td>Video/Tutorial</td><td>Presentation</td><td>Workshops</td><td>Virtual Reality classroom</td><td colspan="2">On Site: Seminar / Workshop / Conference/ Lecture</td></tr>
<tr><td>Quiz</td><td>Q&A</td><td>Innovative Formative Assessment</td><td>Document</td><td colspan="2">Live course</td></tr>
</table>

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5 Conclusion

This deliverable describes the process that has been followed in order to identify the mechanisms to be used for delivering the TRINITY training material in the interested external parties, the methodology of the designing as also the design and development of them. The objective was to satisfy the requirements of the diverse project ecosystem, which dictates that suitable delivery mechanisms are utilised according to the technology and training transfer instance, the competence level of the receiving stakeholder, and the nature of solution that is transferred.

Moreover, an analytical description of the analysis and prioritization of training needs has been presented. The purpose of this task was to analyse the training needs that will be needed to be provided to the interested stakeholders during TRINITY project. Based on the competences provided by each TRINITY partner and focusing on the Internal demonstrations detailed descriptions, each responsible partner identified the requirements on education and training required by the first-time and intermediated users. Lastly, a templated for the description of the content of TRINITY training material has been prepared in order all the partners to provide their input in a uniform way. At section 5 all the TRINITY module owners provided an outline of the TRINITY training material per module, the basic characteristics, the target audiences and the main content.

As next step of WP7 is the preparation of the Novel solution cockpit that will host all the material from the Internal as well as 3rd party demonstrations while comprise user-friendly graphical interfaces that will provide access to such material in the interested stakeholders and first-time and intermediate users. The novel cockpit will be delivered on M20 of the project.

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